

CANOPY FEED METHOD AND APPARATUS FOR A TRIM PRESS

FIELD OF THE INVENTION

[0001] This invention pertains generally to the field of plastic thermoforming equipment and to feeding of thermoformed plastic sheet material.

BACKGROUND OF THE INVENTION

[0002] In the thermoforming or vacuum forming process for producing plastic articles, a continuous sheet or web of thermoplastic is advanced in a step-wise fashion through a thermoforming machine wherein a section of the web is heated to soften it and then drawn into a mold. The plastic sheet assumes the form of the mold, cools and hardens. Generally, the multiple individual plastic parts formed in this manner, such as the common "clamshell" plastic containers, must be cut from the surrounding plastic web material. The formed plastic parts are typically cut from the surrounding sheet in a separate trim press in which the plastic sheet is advanced, section by section, to be engaged by a cutting die which cuts the formed parts out of the surrounding sheet. The trim press typically has an advancement mechanism which engages the plastic sheet to pull each formed section in a step-by-step fashion to the position of the cutting dies.

[0003] In one common arrangement for feeding the formed plastic sheet into the trim press, the continuous plastic sheet is drawn upwardly onto a curved canopy formed of guide rods and then vertically downwardly into the trim press. The typical stationary canopy is formed

of guide rods which laterally orient the position of the plastic sheet so that it is in proper position to be engaged by the driving mechanism within the trim press. The plastic sheet may be driven up the stationary guide rods by rollers driven by a motor controlled by a limit switch. The limit switch is tripped to turn off the motor driven rollers when a section of sheet is discharged from the canopy that corresponds to the length of sheet that will be drawn into the trim press.

[0004] Because the width of the formed plastic sheet and the position of the formed parts in the sheet may vary from one production run to another, the position of the guide rods must be manually adjusted for each production run. The manual adjustment of the positions of the guide rods is relatively time consuming, commonly requiring 45 minutes to an hour and a half depending on whether guide rods need to be added or removed. The adjustment of the guide rods also requires the operator to climb to the top of the trim press to reach all of the guide rods, a physical requirement that although necessary with conventional equipment would preferably be avoided. Other functional disadvantages of conventional stationary guide rods have been observed, including the formation of scratches on the plastic sheet as it is dragged along the stationary guide rods, the presence of plastic dust generated from the sliding plastic, and the potential buckling of thin gauge plastic sheet as it is pulled and then released by the driving mechanism within the trim press. Various designs have been proposed for assisting the feeding of the sheet into the trim press using an oscillating or reciprocating type canopy, for example, as shown in U.S. patents 4,306,474, 4,360,139, and 4,380,183. However, canopy arrangements with stationary guide rods continue to be utilized with standard commercial trim presses.

SUMMARY OF THE INVENTION

[0005] In accordance with the invention, feeding of plastic sheet material to a trim press is carried out utilizing an endless belt conveyor which supports and drives the plastic sheet material being fed to the trim press in a manner which is coordinated with the cycle of drawing of the sheet material into the trim press dies. The surface of the conveyor belt supports the plastic sheet material for upward movement with little or no dragging of the sheet material across the conveyor surface, thereby minimizing scratching of the plastic material and the generation of plastic dust. The conveyor also serves to drive the plastic sheet material up to a discharge position above the trim press rather than requiring that the plastic sheet be pulled by the force of the trim press drive mechanism, reducing stretching of the plastic sheet as compared with conventional stationary canopy guides, and reducing the load imposed on the drive mechanism within the trim press. Adjustment of the position of the plastic sheet being engaged with the conveyor can be easily set by an operator at a position near the bottom or intake end in a quick and convenient manner, minimizing the labor involved in setup and reducing setup time to a few minutes. The apparatus of the invention may be constructed to be set up by an operator without requiring any tools.

[0006] A canopy feed apparatus in accordance with the invention includes frame members forming a frame, an endless belt conveyor mounted to the frame having a conveyor belt with a top facing side extending from an intake end to a discharge end, and a motor connected to the belt to drive the belt. When the apparatus is mounted to feed a trim press, the conveyor extends upwardly from its intake end to its discharge end with a plastic sheet exiting from the discharge end guided

by guide rods downwardly into the trim press. The conveyor belt may be driven continuously to discharge plastic sheet continuously at a rate corresponding to the average rate at which the plastic sheet is drawn into the trim press. The conveyor belt may also be driven in intermittent motion by the motor in a manner that is coordinated with the intermittent feeding of the sheet material into the trim press. The coordination of the conveyor belt motion with the trim press feeding may be carried out utilizing means for detecting a plastic sheet extending outwardly from the discharge end of the conveyor belt a selected distance and for controlling the motor of the conveyor to shut off power to the motor when a section of plastic sheet exiting from the conveyor extends more than the selected distance from the discharge end. The means for detecting can include a limit switch with a trip rod extending therefrom that is mounted such that the trip rod is positioned to be contacted by a section of plastic sheet discharged from the conveyor. The excess plastic sheet exiting from the discharge end of the conveyor bulges out until it reaches the selected distance from the discharge end, at which time the power to the motor for the conveyor is cut off, stopping the conveyor. When the trim press then operates to draw a section of plastic sheet downwardly into the trim press, the excess plastic sheet material is drawn away from the trip rod, resulting in the conveyor motor being turned on and the conveyor belt being driven to feed additional plastic sheet material until the excess material again reaches the trip rod to turn off the conveyor. A blower may be mounted under the conveyor at the discharge end to blow air outwardly to drive the excess plastic sheet outwardly into contact with the trip rod of the limit switch. The feeding of the plastic sheet from the conveyor in this manner is fully coordinated with the drawing of the plastic sheet into the trim press, so that substantially no strain is imposed

on the plastic sheet being fed into the trim press, while at the same time avoiding over-feed of plastic sheet from the conveyor which might interfere with the sheet feeding process.

[0007] Setup of the feed apparatus may be carried out quickly and conveniently utilizing a pair of guide plates and guide wheels mounted for lateral adjustment over the top surface of the conveyor belt at a position near the intake end of the conveyor. Preferably, a pair of mounting bars extend laterally between frame members above the top facing side of the conveyor belt, and the guide plates and guide wheels are mounted for sliding movement on the mounting bars while restraining the guide plates and guide wheels from movement in other directions. A hand operated clamp and a locking mechanism for each guide plate and guide wheel may be utilized by the operator to lock the guide plates and guide wheels at selected lateral positions at which the guide plates are spaced apart a distance equal to the width of the sheet being fed, and such that the sheet being fed will reach the trim press at the proper lateral position. The guide wheels may be mounted for movement toward and away from the top surface of the conveyor, with an air cylinder at each guide wheel being utilized to selectively press the guide wheel into engagement with the plastic sheet supported on the surface of the conveyor.

[0008] Curved guide rods are preferably mounted at the discharge end of the conveyor and extend above and below the position of plastic sheet exiting from the discharge end of the conveyor to guide the plastic sheet downwardly to a proper position for feeding into the trim press.

[0009] Further objects, features and advantages of the invention will be apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the drawings:

[0011] Fig. 1 is a partially cut away perspective view of a canopy feed apparatus in accordance with the invention mounted in a position to feed plastic sheet material to a trim press.

[0012] Fig. 2 is a side view of the canopy feed apparatus of the invention.

[0013] Fig. 3 is a partial view of the intake end of the canopy feed apparatus of the invention.

[0014] Fig. 4 is a partial detailed view of the intake end of the feed apparatus showing the mounting of guide plates and guide wheels above the top surface of the conveyor.

[0015] Fig. 5 is a partial perspective view of the discharge end of the feed apparatus of the invention.

[0016] Fig. 6 is a schematic diagram of the control and drive circuit for the feed apparatus for the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0017] With reference to the drawings, a canopy feed apparatus for a trim press in accordance with the invention is shown generally at 10 in Fig. 1, mounted adjacent to and in position to feed a continuous sheet or web 11 of thermoformed plastic material into a trim press 12. The plastic sheet 11 typically has a series of parts 14 formed therein which are surrounded by the original sheet material and from which the parts 14 are to be cut in the trim press 12. The parts 14, which are formed in a conventional thermoforming apparatus (not shown), extend outwardly from a side of the sheet 11 opposite a flat side 15 as illustrated in Fig. 1. The trim press 12 may be any of the various conventional trim presses that are utilized for trimming formed plastic parts and will not be described further herein.

[0018] The feed apparatus 10 includes a rigid frame 18 formed of frame members (e.g., of conventional structural steel) to which an endless belt conveyor 20 is mounted. The frame 18 serves to provide a structural support for the various parts of the apparatus and may be formed in any desired shape or construction to serve that purpose. For purposes of exemplifying the invention, the frame 18 as shown in the drawings includes two parallel main beams 21, two main vertical beams 22 which extend downwardly from one end of the main beams 21, and two lateral descending beams 24 which extend downwardly and outwardly from the other ends of the main beams 21 opposite that to which the vertical beams 22 are joined. A cross beam 25 extends between and is secured to the two main beams 21 and, as best shown in Fig. 2, braces 27 extend downwardly from the main beams 21 to bases 28 which are fixed to the bottoms of the main vertical beams 22. The beams 21, 22, 24,

25, 27 and 28 are rigidly joined together by, for example, welding, to form a rigid structure. The conveyor 20 is mounted to the frame 18 at a lower end 30 of the lateral descending beams 24 and to the braces 27 at an upper position 31 of the conveyor 20. The conveyor 20 is an endless belt conveyor having rigid stationary side rails 32 which are connected to the frame members at the positions 30 and 31 by, for example, being secured thereto with bolts (not shown).

[0019] The conveyor 20 has an endless conveyor belt 33 that extends from a roller 34 at an intake end 35 of the conveyor to a roller 36 at a discharge end 37, with the endless belt 33 having a top facing side 39 and a bottom side 40. The conveyor belt 33 may be formed of a flexible material, e.g., various synthetic plastics, that is strong and durable and has a desired fairly high coefficient of friction with respect to the plastic material of the bottom surface 15 of the plastic sheet 11. An example of a suitable commercial conveyor is the 3100 Series conveyor from Dorner Manufacturing Co. (Hartland, WI), preferably with a high coefficient of friction belt approved by the FDA for use with packaging for foods (e.g., /03 Soft Top FDA with urethane surface and polyester body). Crossbars 42, as shown in Fig. 1, may extend between the side rails 32 and be secured thereto to rigidify the conveyor structure. As shown in Fig. 2, an electric motor 44 (preferably including a speed reducing gearbox) is connected by a belt 45 to the upper end roller 36 to drive the belt 33 when the motor 44 is supplied with electrical power. For example, a DC motor may be used with a gear reducer (e.g., Tigear 60 to 1 gear ratio from Dodge Gearbox). The conveyor extends upwardly at an angle to horizontal (e.g., about 30° and preferably 28°) from the intake end to the discharge end.

[0020] As best shown with reference to the views of Figs. 3 and 4, a pair of mounting bars 47 extend laterally above the top surface 39 of the conveyor belt and are mounted at their ends to brackets 50 which are secured (e.g., by welding) to the lateral descending beams 24. A ruler 48 is preferably mounted in front of the lower bar 47. A pair of slide bearings 51 slide on the uppermost one of the mounting bars 47 and are connected to brackets 52 which support one end each of a pair of guide plates 54. Another pair of slide bearings 51 are also mounted to slide on the second mounting bar 47 and support slide clamps 55 which each have a hand operated locking mechanism 56 by which the operator can lock the slide clamps 55 in place on the lower mounting bar 47. The slide clamps 55 have brackets 58 connected thereto which are each connected to the forward end of one of the guide plates 54. A pair of guide wheels 60 are mounted for rotation to brackets 62 which are themselves pivotally connected to the brackets 52. Air pressure driven air cylinders 64 are connected at one end to the brackets 52 and at the other end to the pivoting brackets 62. When supplied with air under pressure, the air cylinders 64 extend to drive the guide wheels 60 downwardly into contact with a plastic sheet supported on the top surface 39 of the conveyor. The lateral guide plates 54 serve to properly position the incoming plastic sheet as it reaches the intake end 35 of the conveyor so that when the sheet exits the conveyor it will be properly positioned laterally to be fed appropriately into the trim press. To adjust the lateral position of the guide plates 54, the operator turns the handles of the locking mechanisms 56 on the clamps 55 to release the engagement of the clamps with the lower mounting bar 47 and then moves the guide plate 54 to a desired lateral position, at which the operator turns the handle on the locking mechanism 56 to clamp the guide plate 54 and the

guide wheel 60 carried with it in the proper lateral position. The spacing between the two lateral guide plates 54 is selected to match the width of the plastic sheet being fed. To aid the operator in properly positioning the lateral guide plates, the ruler 48 preferably includes indicia 66 marked on a front face thereof which represent a distance scale (e.g., inches or centimeters, preferably as a half scale for convenience) which can be correlated by the operator with the clamp 55 to determine the lateral position of the clamp from one edge of the conveyor as well as the lateral distance between the two clamps and, therefore, the lateral distance between the two guide plates 54. To aid in the proper support and positioning of the plastic sheet as it is being fed in, the lateral guide plates 54 preferably have lower inwardly extending sections 67 which can engage and support the outer edges of the incoming sheet, and the guide plates may be formed as full channels, each with upper inwardly extending section 68. To further help guide the sheet into place between the guide plates 54, downwardly curved metal tongue extensions 70 may be fixed to the incoming end of the extending section 67 of each guide plate, and extend over the curvature of the conveyor belt at the intake end 35.

[0021] After the operator has adjusted the lateral positions of the guide plates 54 during setup, a new plastic sheet to be fed is inserted between the guide plates 54 and pushed up under the guide wheels 60. Air pressure is then supplied to the air cylinders 64 to drive the guide wheels 60 into contact with the plastic sheet. The guide wheels 60 are preferably positioned at the lateral edges of the plastic sheet, approximately at those portions of the plastic sheet that will ride on the inward extensions 67 of the lateral guide plates 54. The guide wheels 60

press the plastic sheet against the top surface 39 of the conveyor to hold the plastic sheet in position so that it will not tend to wander laterally as it is being fed up the conveyor and to help stabilize the plastic sheet against bunching or wrinkling while it is on the conveyor.

[0022] With reference to Fig. 5, the plastic sheet exiting from the discharge end 37 of the conveyor comes into engagement with and may be supported initially by a set of curved inner guide rods 74 which curve from a horizontal section 75 to a vertical section 76 that extends downwardly toward the trim press. A second, outer set of curved guide rods 78 extend from a generally horizontal section 79 spaced above the position at which the plastic sheet exits the discharge end of the conveyor and curve outwardly and then downwardly to a vertical section 80, with the vertical sections 80 of the guide rods 78 spaced slightly outwardly of the vertical section 76 of the guide rods 74 to hold the plastic sheet 11 between them as it is fed downwardly into proper position in the trim press. The guide rods 78 are preferably set at lateral positions at which they will ride between the formed parts 14 on the sheet 11 or at the edges of the sheet to thereby provide some lateral guiding of the sheet into the trim press 12. The guide rods 74 and 78 function similarly to and may be formed similarly to the conventional guide rods used at the top end of conventional canopy feed systems.

[0023] As best shown in Figs. 2 and 5, a limit switch 84 is mounted to a cross rod 85 which is itself mounted by brackets 86 and 87 to the frame. The limit switch 84 has a downwardly extending trip rod 88 which extends between the outer guide rods 78 at the curved section of the guide rods. The trip rod 88 is outwardly movable to trip the limit switch 84 from a normally closed to an open position. A power line 90

extends from the limit switch 84 to a control box 92 to supply power to and from the limit switch, as explained further below. The trip rod 88 is mounted at a position spaced outwardly a selected distance from the discharge end 37 of the conveyor at a position where it may be contacted by the plastic sheet material 11, as illustrated in Fig. 2. During feeding operation, the conveyor belt 33 is driven by the motor 44 at a constant speed until the plastic sheet that exits from the discharge end of the conveyor bulges outwardly a sufficient distance to contact the trip rod 88 and displace it outwardly to switch the limit switch 84, turning off the power to the motor 44 and stopping the conveyor. As the plastic sheet material 11 is then drawn downwardly into the trim press, the bulging section 94 of the plastic is drawn away from the trip rod 88, allowing the trip rod to return by spring action to its normal position, at which the switch 84 is closed, supplying power to the motor 44 again to drive the conveyor belt 33. A blower 95 may be mounted to the frame beneath the discharge end 37 of the conveyor and is positioned such that the outlet 96 of the blower is directed outwardly from the discharge end of the conveyor to blow the plastic sheet material exiting from the conveyor toward the outer guide rods 78 and toward the trip rod 88, helping to ensure that the maximum extent of the bulge 94 caused by the excess of plastic sheet driven off of the conveyor is directed toward the trip rod 88. It is understood that any other means for detecting that the plastic sheet exiting from the conveyor has reached the selected position may be utilized in place of the trip rod 88 and limit switch 84. Examples include light beam detectors and sonic and other types of proximity sensors.

[0024] In accordance with the invention, the conveyor belt 33 may also be driven at a constant speed that discharges plastic sheet from the

discharge end at a rate that corresponds to the average rate at which plastic sheet is drawn into the trim press. In this mode of operation, utilization of the limit switch 84 is not necessary.

[0025] The positions of the inner guide rods 74 and the outer guide rods 78 are preferably adjustable laterally to suit the size of the plastic sheet being fed and the positions of the formed parts 14 on the plastic sheets. As illustrated in Fig. 5, the inner guide rods 74 may be mounted to manually lockable clamps 97 which are laterally adjustable on a cross rod 98. The outer guide rods 78 are also preferably mounted for lateral adjustment to manually lockable clamps 99 mounted for sliding movement on the cross rod 85 and at the bottom ends of the guide rods to manually lockable clamps 101 which are mounted for sliding movement on a cross rod 102 that is itself mounted to the frame.

[0026] If desired, a set of support wheels 105 may be mounted to the frame in a position to be rotated downwardly to support the apparatus 10 when it is not in use and to be rotated out of the way (to the position shown in Fig. 1) when the feeding apparatus is set up in position to feed plastic sheet material to the trim press.

[0027] The feeding arrangement of the present invention allows an efficient control system to be used for coordinating the feeding of the plastic sheet by the feeding apparatus 10 with the drawing of a plastic sheet into the trim press 12. As illustrated in the simplified schematic diagram of Fig. 6, electrical power from power mains 106 is supplied to the control box 92 that encloses a main on/off switch 108 and a variable speed motor controller 109. The control box 92 is connected by the lines 90 to the limit switch 84 and by power lines 111 to the DC motor 44. A

suitable commercial controller is a Model KBMG-212D variable speed SCR Control from KB Electronics, Inc. The limit switch 84 is connected to a relay coil 115 which when energized closes relay contacts 116 to provide power through the controller 109 to the motor. Several push button switches 118 may be connected in series with the limit switch 84 and are located at various positions to allow an operator to manually stop the conveyor. An adjustable potentiometer 120 connected to the controller 109 allows the output voltage from the controller to be adjusted. A switch 121 may be connected to the controller to allow reversal of the output voltage to reverse the direction of the conveyor. As also shown in Fig. 6, the motor 124 for the blower 96 may be connected to the main switch 108 through an on-off switch 126. Fuses 128 and 129 are connected in the power lines for overload protection. When sheet feeding is to take place, the operator closes the main switch 108, which supplies power to the normally closed limit switch 84. As long as the limit switch 84 remains closed, the variable speed drive 109 is activated. The output power provided from the drive 109 to the motor 44 is adjusted by the operator so that the speed of the conveyor belt 33 is such as to advance an appropriate length of plastic sheet material before the limit switch 84 is tripped as the sheet material engages the trip rod 88. The appropriate length of plastic sheet material that is to be advanced by the conveyor corresponds to the length of plastic sheet material that is drawn into the trim press during each advancement step of a section of plastic sheet material into the trim press cutting dies. The operator can simply adjust the speed of the drive 109 during operation to advance or retard the speed of the conveyor until the right amount of plastic sheet is advanced during each cycle of the trim press.

[0028] It is understood that the invention is not confined to the particular embodiments set forth herein as illustrative, but embraces all such forms thereof as come within the scope of the following claims.

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